Reading in a Foreign Language
ISSN 1539-0578

April 2013, Volume 25, No. 1
pp. 1–25

Character reading fluency, word segmentation accuracy, and reading comprehension in L2 Chinese

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Abstract

This study investigated the relationships between lower-level processing and general reading comprehension among adult L2 (second-language) beginning learners of Chinese, in both target and non–target language learning environments. Lower-level processing in Chinese reading includes the factors of character-naming accuracy, character-naming speed, and word segmentation accuracy. The results of this study show that all three components contribute to reading comprehension in conjunction. Among them, character-naming accuracy was identified as the strongest predictor for reading comprehension; this was followed by character-naming speed. Character reading accuracy was also identified as a major predictor for word segmentation. The findings of this study partially support the studies conducted on alphabetic languages. Based on the results, pedagogical implications are discussed and recommendations for improved teaching are formulated.

Keywords: reading fluency, character recognition, reading comprehension, L2 Chinese

Over the past four decades, reading fluency has been a hot topic, with a special focus on the area of reading in English as a first language (L1) and other alphabetic languages. This is because fluency is considered the key link between word identification and reading comprehension (Bashir & Hook, 2008). Furthermore, fluency is not only an indicator used to distinguish skilled readers from poor readers, but also serves as a strong predictor for reading proficiency (Hudson, Bane, & Pullen, 2005). The significance of fluency for reading instruction will continue to be reinforced by expanding the concepts involved and advancing the scientific methods of measuring it (Samuels, 2006). So far, research on fluency in alphabetic languages has mainly focused on three aspects: first, the relationships between word reading fluency and sublexical fluency, evident in letter-name fluency and letter-sound fluency; phoneme segmentation, which

is the ability to segment phonemes in orally presented words containing two or more phonemes; phonics knowledge such as phoneme-grapheme correspondences; and, orthographic and word knowledge. The results of previous research generally support the concept that there are positive correlations between word reading fluency and the factors mentioned above (Georgiou, Parrila, Kirby, & Stephenson, 2008; Georgiou, Parrila, & Liao, 2008; Katzir et al., 2006; Lloyd, 2005; Ritchey & Speece, 2006).

The second aspect of fluency research deals with examining the relationship between oral reading fluency and reading comprehension. Oral reading fluency includes two forms: context-free word reading fluency and context-based word reading fluency. Context-free word reading fluency refers to accuracy and speed in naming isolated words in a list. Context-based oral reading fluency, on the other hand, is measured by three elements: accuracy, speed and prosody. That is, fluent readers can read with speed, accuracy and proper expression (National Reading Panel, 2000). Various studies have confirmed that both context-free and context-based oral reading fluency contribute to reading comprehension (Jenkin, Fuchs, Van den Broek, Espin, & Deno, 2003; Rasinski et al., 2005; Roehrig, Petscher, Nettles, Hudson, & Torgesen, 2008; Schilling, Carlisle, Scott, & Zeng, 2007; Schwanenflugel, Hamilton, Kuhn, Wisenbaker, & Stahl, 2004; Spear-Swerling, 2006; Wise et al., 2010). The third aspect of fluency research is the effect of fluency instruction on the improvement of reading fluency. Studies have shown that training in reading fluency is generally effective when it comes to improving vocabulary and reading speed and accuracy (Hudson, 2005; Macalister, 2010; Martin-Chang, & Levy, 2005).

The above studies were mainly conducted in alphabetic language-learning settings with a population of school students from kindergarten to grade 12 levels. Few studies have focused on an L2 learning setting for adult learners, especially for a logographic language like Chinese, to determine whether the above-mentioned observations hold true. This study is the first attempt to investigate relationships of reading fluency and reading comprehension in adult L2 Chinese.

Unlike English, Chinese has a character-based orthography and lacks sound-to-script correspondence. In addition, in reading texts, characters representing lexical morphemes and word boundaries are not indicated by a space, which introduces additional complications for lower-level linguistic processing during reading compared to an alphabetic language. Due to its unique orthographic system, students whose native language is alphabetic encounter great challenges when reading Chinese. Therefore, there is a need for empirical studies in Chinese reading instruction investigating the potential connection between oral reading fluency and reading comprehension, and how classroom instruction should utilize the research results in designing reading instruction. The present study investigates the relationship between reading fluency and reading comprehension among beginning learners of Chinese as a foreign language (hereafter CFL) in colleges in both non-target language and target language speaking environments. Specifically, the study explores the relationships between context-free character-reading fluency, word segmentation accuracy and general reading comprehension in different learning settings and seeks the relative contributions of character-reading speed, accuracy, and word segmentation accuracy, to general reading comprehension.

It is hoped that the results of this study will not only enrich reading fluency research across languages, but will also more importantly, shed light on the design of reading curricula and

instruction in L2 Chinese. As a result, recommendations for their improvement can be made.

Recent Studies on L1 Reading Fluency and Its Impact on Reading Comprehension

Although the definition of reading fluency is still expanding, a definition that is generally accepted by scholars at present is that reading fluency is the outcome of the quality of the oral reading of words from connected or disconnected text (Breznitz, 2006). Therefore, for reading text-free words, fluency can be measured by oral reading accuracy and speed. For connected texts, in addition to accuracy and speed, the factor of prosody is included, as "appropriate prosody (phrasing, intonation, and stress) constitutes evidence for discourse comprehension" (Breznitz, 2006, p. 50).

Why is reading fluency important? From a cognitive information processing perspective, the reading process consists of two general components: lexical access and text comprehension (Perfetti, 1985). Lexical access deals with identifying individual words, including their semantic properties. Text comprehension refers to semantic encoding of individual sentences and whole texts. The goal is to generalise a context-appropriate meaning from the reading material. The cognitive processing of lexical access is also referred to as lower-level (or lower-order) processing and text comprehension is referred to as higher-level (or higher-order) processing. During reading, the two levels of processing interact with each other to complete the reading process. Due to individuals' limited attention span and working memory, individual cognitive capacity constrains the simultaneous shifting of attention and activation of memory elements that are required to read in a given period (LaBerge & Samuels, 1974; Perfetti, 1985). Thus, if lexical access and text comprehension demand cognitive resources exceeding the limitations of an individual's cognitive capacity, reading will be extremely inefficient. For reading a connected text, reading fluency is important: It requires high-speed word recognition and grouping words appropriately into meaningful phrases or grammatical units for interpretation without conscious attention. In other words, it is necessary to reach a degree of automaticity for lexical access (Schreiber, 1980). Automatic lexical access enables readers to free up cognitive resources from lower-level processes and use them for higher-level text comprehension. This allows them to complete the reading task successfully and efficiently. This assumption has been supported by a vast number of studies on alphabetic language learning. In this section, we will review studies from the past decade concerning the contributions of reading fluency to reading comprehension in both context-free and context-based conditions.

Spear-Swerling (2006) conducted a study on oral reading fluency and reading comprehension among 61 third-grade students from two schools in two different districts in the United States. A number of tests were administered to measure different types of fluency and reading comprehension. The fluency measure included context-free word reading, the Peabody Picture Vocabulary Test (a picture-word match test), rapid digit naming, rapid high-frequency word naming and context-based oral reading. The Connecticut Mastery Test was used to assess reading comprehension. The result showed that rapid high-frequency word naming was the strongest contributor to context-based oral reading fluency; furthermore, context-based oral reading fluency explained the largest amount of the variance in reading comprehension (about 24%). The study also revealed that word reading fluency, context reading fluency, and reading comprehension are interconnected, forming a chain effect. This observation was supported by

two other studies. One examined the development of phonics knowledge, word-recognition and context-free oral word reading fluency of school children in grades 1-3 (Eldredge, 2005). The result indicated that word recognition and context-free oral reading fluency were necessary conditions for text comprehension. The second study examined the predictive validity of fluency measures among first to third graders from 44 schools in the state of Michigan (Schilling et al., 2007). The fluency measures for that study included letter-name fluency, phoneme-segmentation fluency, nonsense word naming fluency and context-based oral reading fluency. Reading comprehension was measured using the standardised Iowa Tests of Basic Skills. The results of that study confirmed that context-based oral reading fluency was reasonably accurate at identifying poor readers among second and third graders. In another large-scale study, Roehrig et al. (2008) evaluated context-based oral reading fluency and aimed to predict third-grade reading comprehension outcomes among 35,207 third-grade students in Florida's *Reading First* schools. The study revealed a moderate-high correlation (r = .70) between context-based oral reading fluency and reading comprehension performance.

Context-free Reading and Context-based Reading Fluency

A number of studies have compared the relative contribution of context-free reading fluency and context-based reading fluency to comprehension. Jenkins et al. (2003) investigated context-free and contextual reading as determinants to reading comprehension among 113 fourth graders from six schools in a school district in the south-eastern United States. To measure contextual reading fluency, students were asked to read a folktale that had been rewritten for a third-grade reading level. For the context-free reading fluency, the words from the same folktale were presented in a randomly ordered list. For each of the conditions, three scores were collected: accuracy (words read correctly divided by total words read), speed (number of words read correctly in 1 minute) and time used per correct word (measured in seconds). A standardized reading comprehension test requiring reading short passages and answering multiple-choice questions was administered to measure reading comprehension performance. Reading time was not restricted. The correlation analysis showed that reading speed and time of reading for both context-free and context-based materials had positive correlations with reading comprehension. However, context-based reading showed a stronger correlation with reading comprehension and reading speed (r = .83; r = - .74) than context-free reading (r = .54; r = - .56). This result was inconsistent with a similar study conducted by Wise et al. (2010) using a different population, where reading fluency in this latter study was measured under three conditions: nonsense word oral reading fluency, context-free word reading fluency, and context-based oral reading fluency. The relationships between the three fluency conditions and reading comprehension were examined. The results showed that context-free oral word reading fluency had the strongest relation with reading comprehension performance. Another study on oral reading fluency and reading comprehension for more advanced students (Rasinski et al., 2005) investigated fluency and comprehension among ninth grade high school students in the U.S. and the results indicated that there was a moderate correlation (r = .53) between context-based oral reading fluency and reading comprehension.

Studies on L2 Reading Fluency

Droop and Verhoeven (2003) compared the reading comprehension, word decoding, and oral

language proficiency of both third and fourth graders in the Netherlands with Dutch as their L2. Here, reading comprehension was measured by three tests: a multiple-choice test, a reading vocabulary test, and a text cohesion test. Two cloze texts were provided and students had to fill in the appropriate connectives for two sentences. The test for decoding skills consisted of three cards which contained lists of words of differing orthographic complexity. Students had to read as many words as possible in one minute. The oral language proficiency test consisted of three components: (a) vocabulary knowledge, in which both oral receptive (picture-word match) and productive vocabulary knowledge (orally providing definitions for a list of words) were tested; (b) morphosyntactic knowledge, in which knowledge of plurals, conjugation of verbs, and pronominal references were included; and (c) oral language comprehension, in which students listened to short stories and conversation and then answered multiple choice questions. The results showed that for Dutch L2 students, oral vocabulary knowledge in the third grade not only had a strong and direct influence on their reading comprehension at the end of fourth grade, but also an indirect influence on their oral language comprehension.

Lesau and Crosson (2010) investigated oral reading fluency and its relationship to comprehension among 76 Spanish-speaking, English as a foreign language (EFL) learners from the fifth grade. Oral reading fluency was measured using both context-free word reading and context-based reading. Reading comprehension, vocabulary and listening comprehension and decoding skills were also tested. The results showed a moderate correlation between oral reading fluency and reading comprehension. Furthermore, a strong correlation was observed between context-free word fluency and context-based fluency. However, the study failed to clarify which of the two contributed more to reading comprehension overall.

Shiotsu (2009) investigated the relationship between fluency measures and reading comprehension among college students learning English as a second language. The participants were 219 L1 Japanese EFL students from five universities in Japan. The fluency measures included three components. The first was computer-based word recognition speed. Each participant saw a pair of items on the computer screen and responded by pressing a key to indicate whether the two items were synonymous or antonymous. The second component was visual orthographic processing speed. Students were asked to judge orthographic regularities for a pair of items that included real words and pseudo-words with regular or irregular letter strings. The third component was lexical semantic access speed. Students were asked to identify the meaning of high-frequency words. Reading comprehension was measured by two reading comprehension tasks: passage comprehension, in which students had to answer 20 multiple choice questions, and a test for sentence comprehension speed. Students were asked to demonstrate their comprehension of sentence-level items by answering multiple-choice questions written in the L1. Based on the students' reading performance, they were divided into two groups: a higher performing group and a lower performing group. The major findings of this study were that all three fluency measures contributed to reading comprehension for both groups. However, the higher performing group performed faster in the word lexical semantic access test and the orthographic regular unknown words test. In summary, the above studies on L2 reading fluency support the notion that lower-level reading fluency affects text comprehension.

Lower-level Cognitive Processing in Reading Chinese Language and the Current Study

As mentioned above, from a cognitive perspective, the reading process includes components of lexical access and text comprehension (Perfetti, 1985). Lexical access is regarded as lower-level processing and refers to local text processing. Text comprehension is regarded as higher-level processing and uses the outcome of the local text processing to access the meaning of a larger text. As Chinese is a logographic language, Chinese characters are the linguistic units corresponding to orthographic units. Individual characters, as free morphemes, can serve as words, but they can also group with other characters to form multi-character words. A Chinese word can be formed by using one, two, three or more characters. In written text, characters are equally spaced and there are no space boundaries between multi-character words. When a word is formed by multiple characters, character recognition from a multi-character word is roughly equivalent to identifying individual morphemes in a multi-morphemic word in English. Unlike in English, where lower-level processing includes word identification and lexical access, in Chinese it includes three components: character recognition, word segmentation, and lexical access (Shen, 2008; 2011). Character recognition maps the graph to its corresponding sound and meaning; word segmentation groups relevant characters into context-appropriate words; and, lexical access is the semantic encoding of words through the choice of a contextually relevant meaning. Among these three sub-components, word segmentation plays a critical role in accessing higher-level processing and extended text comprehension.

Word segmentation is not an easy task in Chinese. As mentioned earlier, a Chinese character can either stand alone as a word or be joined with other characters to form a multi-character word with a distinct meaning. Consider the following sentence:

一行人站在山坡上，暴风雨搅得他们睁不开眼睛, 很难看清沟底的水情。(modified from *Shouhuo* 收获 magazine, 1986, p. 126)
[Standing on the slope (of the hill), a group of people had difficulty opening their eyes due to the rainstorm, which made it hard for them to see the water level in the ditch.]

If we ignore the context, the character string 一行人 could be grouped in two ways: 一/行人 (a walking person) or 一行/人 (a string of people); furthermore, the character string 很难看 could be grouped into either 很/难/看 (very/difficult/see) or 很/难看 (very ugly). Based on the contextual information, the correct word segmentation for this sentence should be:

一行/人/站在/山坡上/，暴风雨/搅得/他们/睁不开/眼睛/，站不住/脚跟/，很难/看清/沟底的/水情。

Thus, finding the correct word segmentation requires knowledge that goes beyond just understanding the meaning of individual characters. This example shows that word segmentation directly affects lexical access, which in turn affects higher-level reading comprehension.

Due to the complex nature of Chinese morphological compounds, Chinese scholars have different views regarding word boundaries on certain words. One example of this complexity is that many Chinese two-character verbs are not fixed words. Namely, a two-character verb can be considered as one word or two words. Such verbs are referred to as separable verbs. For example, the word 洗澡(to bathe)can be considered as one word and can also be considered as two words

洗 (take) and 澡 (bath). Another example of this complexity is the vague boundary between word and word phrase for some words. Take the example of the character string 男孩子， some native speakers consider it as one word "boy" and others regard it as a word phrase with two words "male child." These complexities introduce difficulties in computing word segmentation accuracy. Therefore, in the current study, we use the number of word segmentation errors rather than the number of accurate segmentations as an index for word segmentation accuracy. The reason for this is that although scholars and native speakers have different views regarding word and word phrase, they have no ambiguity about non-word in a sentential context. To give an example, for the sentence 中国人喜欢用筷子, some native speakers may consider this sentence to contain 4 words (中国人/喜欢/用/筷子 Chinese/like/use/chopsticks) and other native speakers may consider it as having 5 words (中国/人/喜欢/用/筷子 Chinese/people/like/use/chopsticks). However, no native speaker would make word segmentations for this sentence in this way 中/国人/喜/欢用/筷/子 (Chin/esepeople/li/keuse/chopstick/s), because semantically none of the segments in this sentence can be considered as words.

Theoretically, character recognition facilitates word segmentation, and accurate word segmentation initiates successful lexical access. However, in reality, the three sub-processes of lower level processing may not always be sequential. Rather, it is an interactive process: inaccurate lexical access may cause difficulty in text comprehension, notifying the reader that he or she should reconsider the initial word segmentation decision. The reader then needs to re-examine the meaning, or in Chinese, even the sound of individual characters, as some characters have multiple readings. The result of this re-examination might lead to a new combination of character strings, which in turn forms new word segmentation that might change the meaning of the current sentence.

Predicated on automaticity theory (LaBerge & Samuels, 1974) and verbal efficiency theory (Perfetti, 1985), we maintain that reading fluency in Chinese requires rapid and accurate character recognition, word segmentation, and lexical access. These elements free a reader's cognitive resources in terms of lower-level processing so that the comprehension of the meaning of a text can be the focus of attention. Based on this prediction, we assume that lower-level reading fluency directly affects reading comprehension.

The present study examines the relationship of two lower-level processing components, fluent character recognition and word segmentation, with reading comprehension among beginning CFL learners in target language and nontarget language speaking settings. The study focuses on character recognition and word segmentation without including lexical access for two reasons. One is that for reading Chinese texts, due to lack of space boundaries between words, accurate lexical access for a sentential context is not a pure lower-level linguistic process, it requires partial contextual knowledge (higher- level processing) as well. That is, compared with English, lexical access in Chinese is more contextually dependent (Chen, 1999), while fluency dealings only involve lower-level processing. Another reason is that there are no established criteria and methods to measure fluency in lexical access in reading Chinese which itself requires substantial studies.

To be specific, this study seeks to answer three research questions:

(1) What are the relationships between context-free character-reading fluency, word segmentation accuracy, and general reading comprehension, as well as between two lower level process factors: context-free character-reading fluency and word segmentation accuracy?
(2) What are the relative contributions of character-reading speed and accuracy, as well as word segmentation accuracy, to general reading comprehension?
(3) Are there any differences in the relationships between word reading fluency, word segmentation accuracy, and reading comprehension in different learning settings?

In this study, general reading comprehension is determined by a reading test that aims at measuring students' general reading proficiency rather than a textbook-dependent reading achievement test.

This study examines context-free character-reading fluency rather than context-based character-reading fluency. This is because context-based reading fluency includes a component of expression in addition to character-reading speed and accuracy; however, no criteria have been developed for the quantitative measurement of expression in Chinese reading. By adopting context-free reading material, we measure only character-reading accuracy and speed but not expression.

Methods

Participants

The participants of this study were recruited from two sites. Site 1 (hereafter the U.S. site) was an American university in the Midwest, presenting an English language speaking environment. The participants were 44 college students who had just completed their first year of Chinese study. Two students did not complete all the required tasks due to missing class; this reduced the number of participants to 42. Among them, 24 were male and 18 female. One student was from Canada, one was from Italy and the rest were all English-speaking students from the United States. The textbook used for this site was *Integrated Chinese* (Yao et al., 2005). By the time of data collection, the students had completed 19 lessons; they had been introduced to a total of 688 characters and 1,016 non-repeated words. Over the course of the first year of Chinese study, the class met five times per week, 50 minutes per session. Thus, students had received around 120 hours of direct instruction by the time of data collection.

Site 2 (hereafter the China site) was a Chinese-language university in Beijing, China, and therefore a target language speaking environment. Participants were foreign students from different countries that had enrolled in the first-year Chinese course. The data were collected at the end of the first year of Chinese study. Initially, 40 students participated in the study, but four students did not complete all the required tasks; thus, the actual number of participants was 36. Among them, 17 were female and 19 male. Participants were from 26 countries distributed over Asia, Africa, America, and Europe. The textbook used in the class was *Road to Success* (Mu & Zhang, 2008), which was actually a three-volume set of textbooks. The class met five days per week. Each day involved four class periods and each period lasted 50 minutes. In addition, students were required to take one elective course focused on speaking, phonetics, grammar, or

character writing. This resulted in four additional class periods per week. By the end of their first year, the students had been introduced to 1,620 characters and 2,834 non-repeated words. The students had received approximately 230 hours of direct instruction.

In summary, the participants from the two sites were different in several respects: (a) The majority of students from the U.S. site were American, English-speaking Chinese learners, while students from the China site were from various countries and had different native languages; (b) the U.S. site was a non-target language speaking environment and the China site was a target language speaking environment; and (c) the participants' language proficiency differed between the sites. The students from the China site also had twice the number of direct instruction hours. The rationale behind choosing Chinese L2 learners, who had already learned around 1,000 characters or more, was that if students were true beginners, having learned only a handful of characters, it would have been impossible to measure reading comprehension. Clearly, reading comprehension cannot occur if students encounter too many unknown characters. In addition, two different sites for this study were chosen because this allowed us to examine whether the results found for the U.S. site also held true for beginning learners in a different learning setting, with different first language backgrounds and a higher proficiency level.

Measures

Three types of instruments were developed for data collection: the one-minute character-reading test, the word segmentation test, and the reading comprehension test.

One-minute character-reading test. The purpose of the test was to measure students' speed and accuracy in character naming in a text-free condition. One hundred characters were selected from a list of the 800 most frequent Chinese characters, provided by the *Vocabulary and Character Proficiency Guideline* (National Office of Teaching Chinese as a Second Language, 1992). Two forms, Form A and Form B, were created. Form B was identical to From A, except that the order of characters on the list was changed. The purpose of creating two forms was to check test-retest reliability (see Appendix A for Form A).

Two-minute word segmentation test. This test was developed to assess the accuracy of word segmentation within required time period. Two groups of sentences were selected from the reading comprehension test. Group A contained three groups of sentences, which were randomly selected from three reading materials used in the reading comprehension test used for this study. The purpose of selecting sentences from the reading comprehension materials rather than from other materials was that it would allow us to see a direct connection between word segmentation and reading comprehension. Group A's sentences were used to create Task Form A (see Appendix B). An alternative group, Group B, also contained three groups of sentences selected from the alternative reading comprehension test. These sentences were used in Task Form B. The difficulty level for the two groups of sentences was controlled based on word frequency and sentence length. For each group, the mean character frequency index was around 1,200–2,000. The frequency computation for the selected sentences was based on the *Lexicon of Common Words in Contemporary Chinese* (Chinese National Working Committee for Language and Characters, 2008). The purpose of controlling word frequency was to ensure that the words in the word segmentation test were high-frequency words and that they had already been introduced to

the students. The mean sub-sentence length within each complex sentence for each group was around 10–12 characters. The term *sub-sentence* refers to the sub-structures within a complex sentence, separated by punctuation marks such as a comma, semicolon, or colon. The purpose of controlling sentence length was to set the sentence difficulty level, as sentence length is a major factor affecting sentence difficulty (Shen, 2005).

Reading comprehension test. This test was used to measure students' general reading comprehension performance. We first created Test A, which contained five reading materials. In order to keep the difficulty level of the reading materials in line with the students' proficiency level, we selected the reading materials from the basic level of the *Collection of Simulated HSK Testing Papers* (Feng, 2006) and modified them slightly. Based on the materials, reading comprehension questions were formulated by the researcher. The format of questions included multiple choice questions, a cloze test, and open-ended questions. In total, there were 28 questions (see Appendix C for Reading Comprehension Test A). For the purpose of checking the test's reliability, an alternative form, Reading Comprehension Test B, was also created following the same procedure and format described above.

Data Collection, Scoring and Reliability Analysis

*Data collection***.** Data were collected at the end of the spring semester of the first year, during final exam week for both the U.S. site and the China site. All tasks were administered within two days. On day one, the one-minute character-naming test (Forms A and B) and the two-minute word segmentation test (Form A and B) were administered. The following day, students were asked to complete the reading comprehension tests A and B during class.

The one-minute character-reading test and the two-minute word segmentation test were administered individually. Prior to administering the test, a group of graduate assistants working as testers received training in a workshop on how to administer the tests. During the data collection, two testers worked with one student. One tester administered the test and the other was in charge of timekeeping. Directions were given both in oral and in written form, in Chinese as well as in English (for details, see Appendix A and B). For the one-minute character-reading test, each student read the characters while one of the testers marked the student's performance using the following pre-designed codes (teacher's version):

1. Place a dot under characters correctly read
2. Mark an X on characters with pronunciation errors
3. Place a '/' on characters skipped (not read or 'do not know' characters) by the participant

For the reading comprehension test (comprised of Test A and Test B), students were given 30 minutes for each test. They completed the tests in the classroom.

In order to control the practice effect, a counterbalanced method was adopted during data collection. That is, the sequence of working on Form A and Form B was reversed for 50% of the participants on each site.

*Scoring***.** For the one-minute character-naming task, first, the number of accurately named

characters within the one minute period was computed as character-naming accuracy. Second, the total number of characters named, regardless of whether they were accurately named or not, was calculated as character-naming speed. Characters that the participants marked as 'do not know' were excluded. We included inaccurately named characters in the naming speed because we wanted to examine whether students attempted to guess the sounds of characters they were not sure about and whether this "sound-guess" would contribute to reading comprehension.

As mentioned earlier relating to the two-minute word segmentation test, due to the complex nature of Chinese words, native speakers may have different views regarding the segmentation of certain words, thus we computed word segmentation errors as the index for word segmentation accuracy instead of accurately segmented words. The computation involved two steps: In step 1, we identified the errors, and in step 2, the error rate was computed. In order to eliminate the possibility of a difference in rating among raters, all of the raters were given the following criteria for identifying word segmentation errors in a sentential context:

1. A word which is listed as a word in a standardized word dictionary without controversy but was not considered as a word by test-takers. For example, 中国 (China) and 人民 (people) are words; however, if a word mark was placed between the characters, such as 中/国 or 人/民 in a sentence 中国人民不怕难 (Chinese people do not yield to difficulty), this was considered an error.

2. A word mark was placed to group non-word character strings as words. For example, for the character string 中国婚礼很有意思 (Chinese weeding is very interesting), if the word marks were placed as 中/国婚/礼很/有意/思, five errors were identified in the word segmentation, as 中, 国婚, 礼很, 有意 and 思 are all semantically non-words.

3. Two or more words (which have no linguistic controversy on determining them as words), not including particles, were grouped as one word. For example, in the character string 可是没有机会看到, the correct word mark should be 可是/没有/机会/看到 if it is marked as 可是没有/机会看到, two errors were identified.

After counting the number of word segmentation errors, the next step was to compute the word segmentation error (WSE) rate. This was calculated based on the following formula:

$$\boldsymbol{WSE\ rate} = \frac{number\ of\ total\ word\ segmentation\ errors}{number\ of\ total\ characters\ covered\ for\ the\ word\ segmentation}$$

Therefore, individual participants' word segmentation accuracy was determined by their word segmentation error rate: the lower the error rate, the higher the word segmentation accuracy. For the reading comprehension test, each question was scored individually, and all correct answers were accumulated into an overall score. The students could achieve a maximum of 20 points for each of Tests A and B.

Reliability analyses. After the data were collected, two raters (graduate students majoring in teaching Chinese as a second language) rated all testing materials independently. We then randomly selected 20 sets of rated testing materials from each site to conduct the reliability

analyses. For each type of test, scores for Form A and Form B were correlated to analyse test reliability. In addition, since the reading comprehension test included a number of open-ended questions, the inter-rater reliability for the two raters was also computed. For the one-minute character-naming test, the test reliability for the character-naming speed was $r = .92$ ($p < .01$) and was $r = .91$ ($p < .01$) for the character-naming accuracy. For the word segmentation task, the test reliability was $r = .85$ ($p < .01$) and was $r = .79$ ($p < .01$) for the reading comprehension test . The inter-rater reliability for the reading comprehension test was $r = .97$ ($p < .01$).

Analyses and Results

Research Question 1: *What are the relationships between context-free character-reading fluency, word segmentation accuracy, and general reading comprehension, as well as between two lower-level process factors: context-free character-reading fluency and word segmentation accuracy?*

In order to answer this question, a zero-order correlation test was conducted with four variables: one-minute character-reading speed, one-minute character-naming accuracy, two-minute word segmentation error rate, and reading comprehension. As character-reading fluency consists of two components—speed and accuracy—we correlated both character-naming speed and accuracy with reading comprehension. The results of the descriptive statistics of the four variables and the correlation analyses from the U.S. and China sites are shown in Table 1.

Table 1. *Zero-Order correlation for character reading accuracy, speed, word segmentation accuracy (WSE) and reading comprehension*

Measure	1. RC	2. CA	3. CS	4.WS	M	SD
U.S. Site (N = 42)						
1. RC	--	.64**	.55**	- .50**	12.17	5.34
2. CA	.64**	--	.97**	- .50**	25.09	15.83
3. CS	.55**	.97**	--	- .45**	34.83	17.23
4. WS	- .50**	- .50**	-.45**	--	7.00	5.00
China Site (N = 36)						
1. RC	--	.79**	.31*	- .51**	13.97	3.38
2. CA	.79**	--	.58**	- .51**	29.14	10.38
3. CS	.31*	.58**	--	- .32*	40.58	13.03
4. WS	- .51**	- .51**	-.32*	--	5.00	3.00

Note. RC = reading comprehension; CA = character reading accuracy;
CS = character reading speed; WS = word segmentation accuracy (presented as WSE).
* $p < .05$; ** $p < .01$

The descriptive statistics from Table 1 show that for reading comprehension performance, the mean score from the China site was 1.80 points higher than that of the U.S. site; for character-naming accuracy, it was 4.05 points higher; and for the character-naming speed it was 5.75 points higher. For word segmentation, the mean error rate from the China site was 2 points lower than that of the U.S. site. The standard deviations for all items for the China site were smaller

than those for the U.S. site. Judging from mean scores and standard deviations, the participants from the China site exhibited superior performance to those from the U.S. site on all tasks. This was not surprising, as students from the China site had been introduced to more characters and words.

The zero-order correlation from the U.S. site showed that the students' performance on the reading comprehension test had a moderate-high positive correlation with character-naming accuracy (r = .64), a moderate correlation with character-naming speed (r = .55) and moderate negative correlation with WSE (r = - .50). That is, the lower word segmentation error, the higher the reading comprehension. For the China site, we observed a high-moderate correction between reading comprehension and character-naming accuracy (r = .79), a low correlation between reading comprehension and character-naming speed (r = .31) and a moderate negative correlation between reading comprehension and WSE (r = - .51). Therefore, we concluded that character-naming accuracy, speed, and word segmentation accuracy all have a statistically significant association with the reading comprehension.

On the other hand, from this zero-order correlation matrix, we also observed inter-correlations among character-naming accuracy, character-naming speed, and word segmentation accuracy. This suggests that the correlation we observed between reading comprehension and the other three components also included the inter-correlations among these three components. In order to determine the net correlation of reading comprehension with each of the three components, a partial correlation was performed.

The partial correlation (see Table 2) showed that for the U.S. site, the net correlations between reading comprehension and character-naming accuracy were r = .49 and r = .33, respectively, after controlling for the variables of the character-naming speed and word segmentation accuracy. For the China site, the net correlations for reading comprehension and character-naming speed were r = .36 and r = .30. The net correlations for reading comprehension and word segmentation accuracy were relatively weak for both US and China sites (r = - .23 and r = - .22), which was not statistically significant. The result of the partial correlation showed that word segmentation alone did not have a strong association with reading comprehension. However, from the zero-order correlation matrix, we inferred that word segmentation had a moderate correlation with character-naming accuracy and a moderate-low correlation with character-naming speed. This suggests that the increase of reading fluency, expressed through character-naming accuracy and speed, also increases the accuracy of word segmentation.

Table 2. *Partial correlation between reading comprehension and character reading accuracy, speed and word segmentation*

Measure	1. RC	2. CA	3. CS	4. WS
U.S. site (N = 42)				
1. RC	--	.49**	.36*	- .23
China site (N = 36)				
1. RC	--	.33**	.30*	- .22

Note. RC = reading comprehension; CA = character reading accuracy;
CS = character reading speed, WS = word segmentation accuracy (presented as WSE).
* $p < .05$; ** $p < .01$

A multi-regression analysis was further performed to pinpoint the relative contributions of character-reading accuracy and speed to word segmentation. Table 3 shows the results of the multiple regression analysis for the U.S. and China sites. Character naming accuracy alone explained 25% of the variance of word segmentation for the U.S. site. By adding word reading speed, 28% of variance was explained. That is, word reading speed alone explained 3% variance to word segmentation. For the China site, character-naming accuracy alone explained 26% of the variance for word segmentation. The character-naming speed alone did not explain any further variance in word segmentation. As shown in Table 1, students from the China site had higher character-reading speed (41 characters per minute) than those from the U.S. site (35 characters per minute). It is possible that when character-reading speed reaches a certain threshold, a ceiling effect is triggered, which means that it does not further affect reading comprehension. Rather, character-reading accuracy becomes an important factor for word segmentation.

Table 3. *Multiple regression analysis for word segmentation and character reading fluency*

Predictor	R	R^2	ΔR^2	95% CI
U.S. site (N =42)				
1. CA	.50**	.25	.23	[- .002, -.001]
2. CS	.53	.28	.27	[- .001, .005]
China site (N = 36)				
1. CA	.50**	.26	.24	[.18, .33]
2. CS	.50	.26	.22	[- .13, .02]

Note. CA = character reading accuracy; CS = character reading speed; ΔR^2 = adjusted R^2 dependent variable = word segmentation accuracy (WS); * $p < .05$; ** $p < .01$

Research Question 2: *What are the relative contributions of character-reading speed, character-reading accuracy and word segmentation accuracy to the reading comprehension performance?*

Further multiple-regression analyses were performed to determine the relative contributions of the three components—character-naming accuracy, character-naming speed, and word segmentation accuracy—to reading comprehension. The results (see Table 4) showed that at the U.S. site, character-naming accuracy was a major contributor to general reading comprehension, explaining 41% of the variance for reading comprehension. The next contributor was character-naming speed, which explained 8% of the variance for reading comprehension. Word segmentation alone was not a significant contributor, as it explained only 1% of the variance. The results from the China site showed a similar trend, wherein 59%, 3%, and 1% of the variances were explained. Therefore, we can conclude that for lower-level processing in reading Chinese, character-naming accuracy within fixed time (one-minute in this study) play a dominant role in reading comprehension.

Table 4. *Multiple regression analyses predicting reading comprehension from character reading accuracy, speed and word segmentation accuracy*

Predictor	R	R^2	ΔR^2	95% CI
U.S. site (N = 42)				
1. CA	.64**	.41	.40	[.22, .85]
2. CS	.70**	.50	.48	[- .62, - .05]
3. WS	.73	.53	.49	[- 51.09, - 8.3]
China site (N = 36)				
1. CA	.78**	.61	.59	[.18,.33]
2. CS	.80	.63	.62	[- .13, .02]
3. WS	.81	.66	.63	[- 49.13, 10.74]

Note. N = 36. CA = character reading accuracy; CS = character reading speed, WS = word segmentation accuracy; ΔR^2 = adjusted R^2
dependent variable: reading comprehension (RC). * $p < .05$; ** $p < .01$.

Research Question 3: *What are the similarities and differences between the relationships of lower-level processing and reading comprehension for the two sites?*

Even though there were differences among the language proficiency levels in the different language learning environments for the beginning learners, the correlation and regression analyses showed that there was a robust tendency from the two sites wherein character-reading fluency (character-naming accuracy and speed) was strongly correlated with reading comprehension. Character-naming accuracy was the strongest predictor for reading comprehension. It was also the sole strong predictor for word segmentation accuracy after the character-reading speed reached its threshold of about 41 words per minute.

One difference we observed was a high correlation between character-naming accuracy and speed for the U.S. site (r = .97), but only a moderate-high correlation for the China site (r = .58). This phenomenon may be caused by the increase of vocabulary knowledge in the China group. As we mentioned earlier, the China group learned more characters and words and had more direct teaching hours than the U.S. group. It seems that students with relatively lower vocabulary knowledge only named the characters they knew how to pronounce. As character and vocabulary knowledge increased, students had more confidence to guess the sound of characters by using learned orthographic knowledge; therefore, the Chinese group made more pronunciation errors in character naming because they would guess if they did not know for sure, which decreased the correlation between naming accuracy and speed. Although higher-proficiency students made guessing errors in character pronunciation, overall, the character-naming speed was still a factor that contributed to reading comprehension.

Students from the China site showed better performance on all items than those from the U.S. site. Compared to the U.S. site, the China site showed an increase of 16% for character-naming accuracy, an increase of 17% in the character-naming speed, and a 29% decrease in the word segmentation error rate. Altogether, this contributed to an increase in the reading comprehension rate by 14.8%. These results suggest that an increase in lower-level reading fluency will also increase the overall reading comprehension.

Discussion

This study investigated the relationship between lower-level processing and general reading comprehension among adult beginning CFL learners in two different learning settings (a target language speaking setting vs. a non-target language speaking setting) and two different populations (American learners of Chinese vs. international learners of Chinese). Lower-level processing in this study included character-naming accuracy, speed, and word segmentation accuracy. The results of study yield a couple of findings.

One major finding is that all three lower-level processing components in combination contribute to reading comprehension regardless of differences in learning environments and learners' populations. Among them, character-naming accuracy within a fixed time (one minute for this study) was the strongest predictor for reading comprehension. That is, the number of accurate character-naming instances within a controlled time is the most important factor affecting reading comprehension. Partial correlation revealed that character-naming speed, including inaccurate sound-guesses, also showed a low but statistically significant correlation to reading comprehension (r = .36 for the U.S. site and r = .30 for the China site). However, we also observed a high correlation (.97) between character-naming accuracy and speed at the U.S. site. This indicates that learners with higher character-naming accuracy also achieved higher character-naming speed. There was a drop in the correlation from high to moderate between character-naming accuracy and speed at the China site (r = .58). As shown in Table 1, we learned that the mean character-naming speed for the U.S. site was 35 characters per minute, while for the China site it was 41 characters per minute. The relatively lower correlation between character-naming accuracy and speed at the China site, as compared with the U.S. site suggests a trend whereby once character-naming speed reaches a certain threshold, it no longer acts as a significant factor in reading comprehension. Further studies are needed to determine the ceiling effect of character-naming speed in relation to reading comprehension.

The major finding of this study suggests that oral reading fluency is an important indicator for reading comprehension in Chinese, which is partially consistent with studies conducted for alphabetic languages (Eldredge, 2005; Roehrig et al., 2008; Spear-Swerling, 2006); namely, oral reading fluency contributes to reading comprehension.

Earlier, we mentioned that Chinese lacks sound-to-script correspondence. The current study suggests that regardless of the difference in orthographies, phonological knowledge (i.e., access to the sound of a character) contributed to reading comprehension. Over the last three decades, scholars have been investigating the role of phonological knowledge in character recognition. Some studies suggested that character recognition went from orthography to sound to meaning (Perfetti & Li, 1998; Perfetti & Zhang, 1991) while others proposed that orthographic and phonological information functioned interactively to activate the meaning of a character (Zhou & Marslen-Wilson, 1999, 2000). Although scholars still have differing views about the point at which phonological knowledge is activated during character recognition, they have reached a consensus that, similar to learning an alphabetic language, phonological information plays a role in Chinese character recognition. From a classroom perspective, the current study extends the role of phonological knowledge, which not only contributes to character recognition but to text comprehension as well.

The other finding is that multiple-regression analyses showed a similar trend for both the U.S. site and the China site, wherein character naming accuracy explained an approximate 25-26% (Table 3) variance of word segmentation, and character naming speed explained 26-28% (Table 3) variance of word segmentation. This result suggests that word segmentation accuracy and speed depend heavily on character reading accuracy and speed. In other words, the increase of character reading fluency (accuracy and speed) is key to improving lower-level reading processing, which includes word segmentation accuracy.

Pedagogical Implications

The findings of the current study suggest that systematic training in character reading fluency should be an agenda in Chinese reading curricula for the purpose of improving reading comprehension. Pedagogically, at least two fluency-based instructional approaches can be incorporated into our reading instruction: reading aloud and repeated reading.

Reading Aloud

Reading aloud was a popular method used for beginning learners in traditional Chinese reading instruction for native speakers in the Chinese history of language education. However, this method received heavy criticism in modern times which diminished its popularity in classroom instruction. The major criticism is that reading aloud is only good for rote memorization but not helpful for reading comprehension, because reading out loud requires the involvement of oral and aural modalities, which demand more cognitive resources than silent reading. As a result, it slows down the reading rate, which in turn affects the quality of reading comprehension. It is true that for a skilled reader, silent reading is much faster than oral reading; however, for beginning readers, as their word recognition rate has not reached the threshold of automaticity, it would be difficult to free up cognitive resources for higher-level linguistic processing. Thus, we would argue that reading aloud is an effective way of improving reading fluency for CFL learners, as this will enhance character-reading accuracy and speed. One of the benefits of this method is that it helps learners to make sound-graph connections. From a cognitive perspective, Chinese script lacks sound-to-graph correspondence, which causes great difficulties for students when it comes to memorising the sound of individual characters. Reading aloud allows them to hear the sound of individual characters repeatedly, thereby creating a link between the sound and the graph. A second benefit of reading aloud is that it allows instructors to identify students' oral reading problems through oral miscue analysis (Gillet & Temple, 1994). Oral reading miscues such as character substitution, omission, insertion, reverse character order, mispronunciation and tonal errors allow the instructor to detect problems easily and correct them in a timely manner. This will help students improve their oral reading accuracy. A third benefit is that, due to the drastic differences between Chinese and English orthographies and the complexity of the physical structure of Chinese characters, beginning learners often make character-writing errors. Compared to silent reading, reading aloud will force students to keep their eyes on every character in the text as they sound it out loud. It increases visual exposure to physical structure of characters. Accordingly, it facilitates the memorisation of the graphic structure of characters. Finally, reading aloud allows instructors to observe students' expressions (prosody) and to

provide appropriate intervention. Prosody includes changes in pitch (loudness), stress and pausing, which are natural external representation of a student's semantic encoding of text. A recent study showed that students who demonstrated high performance in reading comprehension also used appropriately consistent expression when reading stories and information text out loud (Klauda & Guthrie, 2008). Inappropriate pitch, stress and pausing reflect students' problems in reading comprehension. Therefore instructors can intervene accordingly to help students overcome their comprehension problems.

Repeated Reading

Repeated reading refers to a student reading the same instructional-level passage repeatedly until meeting a pre-set criterion of fluency (Kostewicz & Kubina, 2010). Numerous studies have shown that repeated reading improves reading speed, word recognition accuracy, and reading comprehension, as well as facilitating growth in language knowledge (Dowhower, 1987; Gorsuch & Taguchi, 2010; Kostewicz & Kubina, 2010; LeVasseur, Macaruso, & Shankweiler, 2008; Taguchi, Takayasu-Maass, & Gorsuch, 2004; Therrien & Kubina, 2007; Han & Chen, 2010).

Repeated reading can be either oral or silent. In oral repeated reading activities, the reading rate is calculated by dividing the number of characters read correctly by the total amount of reading time. In silent reading, reading speed (characters per minute) is recorded. A major drawback of this activity is that students may get bored after repeatedly reading the same material. Therefore, promoting students' reading interest is important when designing repeated reading activities. There are many ways to motivate students to read: one method is paired-reading, in which students make recordings of their peers' reading errors (such as oral reading miscues) and speed. They then provide feedback to each other after each reading. Another method is task-based reading, in which different reading comprehension tasks are provided for the same reading material. After each reading, students are asked to complete a different set of reading comprehension tasks. Third, there is self-evaluating reading, in which individual students are required to audio-record their own reading; after each reading, students listen to the audio and perform a self-evaluation of their reading progress, measured through factors such as progress in reading accuracy and speed. Question-directed reading is another method of motivating students to read in the classroom. Here, the teacher asks a question and the student answers by reading a relevant sentence or paragraph from the text. Finally, organising oral reading contests is an excellent way to motivate students to read.

Conclusion

This study revealed that character-reading fluency, which comprises character-naming accuracy and speed, makes an important contribution to reading comprehension among beginning adult CFL students. Therefore, it is necessary to create a fluency-based reading curriculum. Although this study concluded that character-reading fluency is an essential condition for reading comprehension, it was unable to suggest a base character-reading fluency rate for the general reading comprehension. Thus, we are not able to determine the minimum character-reading accuracy and speed a reader should reach in order to obtain the most effective reading

comprehension, or in other words, at which level of accuracy and speed rate, one can be considered to have reached automaticity in the lower-level reading processes. Further investigations are needed along this line of research. While we emphasised the need for a fluency-based curriculum in reading education, we should keep in mind that the goal of fluency training is to help students free up cognitive resources from lower-level processing, thereby enabling more attention to be paid to higher-level processing such as grammar, syntax and semantics of the sentential context. Lower-level fluency will never be able to replace higher-order reading skill training, which leads to higher-order processing. Thus, we do not wish to emphasise oral (or silent) reading fluency while neglecting other components which contribute to higher-order processing in reading. In general, we pay more attention to reading fluency in lower-level reading classes. Once students have reached the threshold of character processing automaticity, as students' literacy knowledge increases, we should shift our focus gradually from lower-level processing fluency to higher-level processing accuracy.

Acknowledgments

This study is supported by a Faculty Research Grant from the Centre for Asian and Pacific Studies, The University of Iowa. The grant was awarded to the first author of this paper. We wish to thank the former graduate students, Ting Huang and Shu Zhu; instructor Xiaoyuan Zhao from The University of Iowa; former MA students Wenxiu Zhu, Li Yang, Haiwei Zhang, Jianrong Du, Yan Zheng and Yu Tang; and instructors Li Zhang, Hongdan Shen, Xiaoli Gao, Shulin Guo and Feng Wang from Beijing Language and Culture University for assisting in the data collection. We also wish to thank former graduate students Xi Ma and Fengping Yu from The University of Iowa for assisting in the data processing for this study.

References

Bashir, A. S., & Hook, P. E. (2008). Fluency: A key link between word identification and comprehension. *Language, Speech, and Hearing Services in Schools*, *40*, 196–200.

Breznitz, Z. (2006). *Fluency in reading: Synchronization of processes*. Mahwah, NJ: Lawrence Erlbaum and Associates.

Chen, H-C. (1999). How do readers of Chinese process words during reading for comprehension. In J. Wang, A. W. Inhoff, & H-C. Chen (Eds.) *Reading Chinese script* (pp 257–278). Mahwah, NJ: Lawrence Erlbaum Associates.

Crosson, A. C., & Lesaux, N. K. (2010). Revising assumptions about the relationship of fluent reading to comprehension: Spanish-speakers' text-reading fluency in English. *Reading and Writing*, *23*, 475–494.

Dowhower, S. L. (1987). Effects of repeated reading on second-grade transitional readers' fluency and comprehension. *Reading Research Quarterly*, *22*, 389–406.

Droop, M., & Verhoeven, L. (2003). Language proficiency and reading ability in first-and second-language learners. *Reading Research Quarterly*, *38*, 78–103.

Eldredge, J. L. (2005). Foundations of fluency: An exploration. *Reading Psychology*, *26*, 161–181.

Feng, F. (2006). *多媒体 HSK 模拟考试试题集* [Multimedia HSK Simulated Testing-Paper

Collection]. Beijing: Beijing Language and Culture University Press.
Georgiou, G. K., Parrila, R., Kirby, J. R., & Stephenson, K. (2008). Rapid naming components and their relationship with phonological awareness, orthographic knowledge, speed of processing, and different reading outcomes. *Scientific Studies of Reading*, *12*, 325–350.
Georgiou, G. K., Parrila, R., & Liao, C-H. (2008). Rapid naming speed and reading across languages that vary in orthographic consistency. *Reading and Writing*, *21*, 885–903.
Gillet, J. W., & Temple, C. (1994). *Understanding reading problems: Assessment and instruction* (4th ed.). New York, NY: Harper Collins.
Gorsuch, G., & Taguchi, E. (2010). Developing reading fluency and comprehension using repeated reading: Evidence from longitudinal student reports. *Language Teaching Research*, *14*, 27–59.
Han, Z., & Chen, C-L. A. (2010). Repeated-reading-based instructional strategy and vocabulary acquisition: A case study of a heritage speaker of Chinese. *Reading in a Foreign Language*, *22*, 242–262.
Hudson, R. F. (2005). Reading fluency assessment and instruction: What, why, and how. *The Reading Teacher*, *58*, 702–714.
Hudson, R., Lane, H., & Pullen, P. (2005). Reading fluency assessment and instruction: What, why and how? *The Reading Teacher*, *58*(8), 702–714.
Jenkins, J. R., Fuchs, L. S., Van den Broek, P., Espin, C., & Deno, S. L. (2003). Sources of individual differences in reading comprehension and reading fluency. *Journal of Educational Psychology*, *95*, 719–729.
Katzir, T., Kim, Y., Wolf, M., O'Brien, B., Kennedy, B., Lovett, M., & Morris, R. (2006). Reading fluency: The whole is more than the parts. *Annals of Dyslexia*, *56*, 51–82.
Klauda, S. L., & Guthrie, J. T. (2008). Relationships of three components of reading fluency to reading comprehension. *Journal of Educational Psychology*, *100,* 310–321.
Kostewicz, D. E., & Kubina, R. M., Jr. (2010). A comparison of two reading fluency methods: Repeated readings to a fluency criterion and interval sprinting. *Reading Improvement*, *47*, 43–63.
LaBerge, D., & Samuels, S. J. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology*, *6*, 293–323.
LeVasseur, V. M., Macaruso, P., & Shankweiler, D. (2008). Promoting gains in reading fluency: A comparison of three approaches. *Reading and Writing*, *21*, 205–230.
Lloyd, J. (2005). Foundation of fluency: An exploration. *Reading Psychology*, *26*, 161–181.
Macalister, J. (2010). Speed reading courses and their effect on reading authentic texts: A preliminary investigation. *Reading in a Foreign Language*, *22*, 104–116.
Martin-Chang, S. L., & Levy, B. A. (2005). Fluency transfer: Differential gains in reading speed and accuracy following isolated word and context training. *Reading and Writing*, *18*, 343–376.
Mu, S., & Zhang, H. (2008). *Road to Success* [成功之路-进步篇]. Beijing: Beijing Language and Culture University Press.
National Office for Teaching Chinese as a Second Language (1992). *Vocabulary and character proficiency guideline* [汉语水平词汇与等级大纲]. Beijing: Beijing Language and Culture University Press.
National Reading Panel (2000). Chapter 3: Fluency. In *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction*. Reports of the subgroups. Retrieved

http://www.nichd.nih.gov/publications/nrp/report.cfm
National Working Committee for Language and Characters (2008). *Lexicon of common words in contemporary Chinese* [现代汉语常用词表 (草案)]. Beijing: The Commercial Press.
Perfetti, C. A. (1985). *Reading ability.* New York, NY: Oxford University Press.
Perfetti, C. A., & Li, H-T. (1998). The time course of graphic, phonological, and semantic activation in Chinese character identification. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 24, 101–118.
Perfetti, C. A., & Zhang, S. (1991). Phonological processes in reading Chinese characters. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17, 633–643.
Rasinski, T. V., Padak, N. D., McKeon, C. A., Wilfong, L. G., Friedauer, J. A., & Heim, P. (2005). Is reading fluency a key for successful high school reading? *Journal of Adolescent and Adult Literacy*, *49*, 22–27.
Ritchey, K. D., & Speece, D. L. (2006). From letter names to word reading: The nascent role of sublexical fluency. *Contemporary Educational Psychology*, *31*, 301–327.
Roehrig, A.D., Petscher, Y., Nettles, S. M., Hudson, R. F., & Torgesen, J. K. (2008). Accuracy of the DIBELS oral reading fluency measure for predicting third grade reading comprehension outcomes, *Journal of School Psychology*, *46*, 343–366.
Samuels, S. J. (2006). Reading fluency: Its past, present, and future. In T. Rasiinski, C. Blachowicz, & K. Lems (Eds.), *Fluency instruction: Research-based best practices* (pp. 7–20). New York, NY: The Guilford Press.
Schilling, S. G., Carlisle, J. F., Scott, S. E ., & Zeng, J. (2007). Are fluency measures accurate predictors of reading achievement? *The Elementary School Journal*, *107*, 429–448.
Schreiber, P. A. (1980). On the acquisition of reading fluency. *Journal of Reading Behavior*, *12*(3), 177–186.
Schwanenflugel, J. M., Hamilton, A. M., Kuhn, M. R., Wisenbaker, J. M., & Stahl, S.A. (2004). Becoming a fluent reader: Reading skill and prosodic features in oral reading of young readers, *Journal of Educational Psychology*, *96*, 119–129.
Shen, H. H. (2005). Linguistic complexity and beginning-level L2 Chinese reading. *Journal of the Chinese Language Teachers Association*, *40*, 1–28.
Shen, H. H. (2008). An analysis of word decision strategies among learners of Chinese, *Foreign Language Annals*, *41*, *501–524.*
Shen, H. H. (2011). *Teaching Chinese as a Second Language: Vocabulary acquisition and instruction.* Beijing: Beijing University Press.
Shiotsu, T. (2009). Reading ability and components of word recognition speed: The case of L1-Japanese EFL learners. In Z. Han & N.J. Anderson (Eds.) *Second language reading research and instruction,* (pp. 15–37). Ann Arbor, MI: The University of Michigan Press.
Spear-Swerling, L. (2006). Children's reading comprehension and oral reading fluency in easy text. *Reading and Writing*, *19*, 199–220.
Taguchi, E., Takayasu-Maass, M., & Gorsuch, G. J. (2004). Developing reading fluency in EFL: How assisted repeated reading and extensive reading affect fluency development. *Reading in a Foreign Language*, *16*, 70–96.
Therrien, W., & Kubina, R. M., Jr. (2007). The importance of context in repeated reading. *Reading Improvement*, *44*, 179–88.
Wise, J.C., Sevcik, R. A., Morris, R. D., Lovett, M. W., Wolf, M., Schwanenflugel, P. (2010). The relationship between difference measures of oral reading fluency and reading comprehensions in second-grade students who evidence different oral reading fluency

difficulties. *Language, Speech, and Hearing Services in Schools*, *41*, 340–348.
Yao, T-C., Liu, Y., Ge, L., Chen, Y-F., Bi, N-P., Wang, X., & Shi, Y. (2005). *Integrated Chinese* (level 1, part 1 & 2). Boston: Cheng & Tsui Company.
Zhou, X., & Marslen-Wilson, W. (1999). Phonology, orthography, and semantic activation in reading Chinese. *Journal of Memory and Language*, 41, 579–606.
Zhou, X., & Marslen-Wilson, W. (2000). The relative time course of semantic and phonological activation in reading Chinese. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 26, 1245–1265.

Appendix A

One-minute character naming test: Student version (Form A)

Please read aloud the following characters, line by line as quickly as you can, once you hear 'start' from your instructor. During your reading, if you encounter a character that you do not know how to read, please say 'don't know' or '不知道', then go to the next character. If you encounter a character with more than one pronunciation, please just give one pronunciation. Once you hear 'stop' from your instructor, please stop your reading. We will time your reading speed. The total time is one minute.

Code	1	2	3	4	5	6	7	8	9	10
1	爸	答	感	绩	课	哪	容	堂	鞋	员
2	半	蛋	歌	家	困	内	商	题	兴	杂
3	北	的	公	检	老	牛	身	挺	续	怎
4	边	典	关	江	历	排	师	推	演	找
5	不	冬	过	较	脸	篇	史	碗	要	支
6	参	段	号	界	了	破	市	为	宜	志
7	常	发	红	睛	录	气	舒	握	义	主
8	城	访	画	酒	嘛	桥	谁	西	应	着
9	除	风	黄	觉	冒	情	嗽	下	邮	族
10	吹	父	鸡	棵	米	确	他	想	雨	作

Appendix B

Word segmentation test: Student version (Form A)

Name_____ University _____Chinese class level _____
As you read the sentence, please use '/' to mark word boundaries. Do not read the sentence until you hear 'start'. Once you hear stop, please put a '//' as a stop mark. We will record the time you take to do the word segmentation. The total time is two minutes. Please finish as much as you can.

For example: 他是中文老师。 他/是/中文/老师。
Group A

1. 我早听说中国婚礼很有意思，可是没有机会看到。最近我的一个中国朋友要结婚，让我做伴娘，我终于有机会能见识一下中国婚礼了。

2．中国的环境污染越来越严重，也越来越引起人们的重视。环境污染由各种因素造成，其中工业上的废水、废气对环境的危害最大。

3．最近中国出版研究做了一项调查。调查的对象是中国 18-39 岁的青年人；调查的内容是这些人的读书情况。

Appendix C

Reading comprehension test 阅读测验*: Student version (Form A)*

Name_____ University _____ Chinese class level _____

Reading One 阅读一 (Please circle the most suitable word based on the context) 4 points

甲：今年国庆节你准备去哪儿？

乙：我想去北京欣赏香山的风景，你呢？

甲：我 **(只，打算，希望，理想)** 待在学校，准备写论文。

乙：你（**之前，今后，原来，从前**）不是打算去亲戚家吗，(**这么，怎样，怎么，如何** ）又改变主意了？

甲：是啊（**就是，还是，可是，总是** ）我的导师让我赶紧把论文写出来，我想利用国庆休假写论文。

乙：你是一个好学生，我祝你过一个快乐的写作节。

Reading Two 阅读二 (please circle one item from the list of four)4 points

我早听说中国婚礼很有意思，可是没有机会看到。最近我的一个中国朋友要结婚，让我做伴娘，我终于有机会能见识一下中国婚礼了。中国人结婚一般不去教堂，更有意思的是男方可以自己开车去女方家把女方接到自己家里。中午，新人的亲朋好友都聚集在餐馆喝喜酒。新人要挨个给亲戚朋友敬酒。一个有趣的事是，我陪新娘去换衣服的时候，发现她的衣兜里有桂圆，便问新娘是怎么回事，她的脸一下子就红了，说是中国人的习俗，是早生贵子的意思。

1．下面哪一项文章中没提到？

A 中国人结婚都去教堂　　B 男方可以开车去接女方

C 亲戚朋友们在一起喝喜酒　　D 男方女方要穿礼服

2．“新人”的意思是

A 新来的客人　　B 结婚的男方和女方

C 伴娘　　D 亲朋好友

3．根据文章，在新娘的衣兜里放桂圆是希望

A 一家团圆　　B 新娘早生小孩

C 生活过得好　　D 婚姻长久

4．根据文章，关于中国婚礼，你觉得下面哪一项是不对的？

A 跟西方的婚礼差不多　　B 有伴娘

C 很热闹　　D 大家都喝酒

Reading Three 阅读三 (Please fill in any word that make sense to you according to the context. The word can be one or more characters)6 points

农历八月十五，是中秋节。中秋节___中国的传统节日，是中国人为了家人能够团圆而形成的习俗。古人认为八月____的月亮最圆，____能代表家人团圆。在_____的时候，家庭成员_____团聚的就会互相思念。另外_____在中秋节_____习惯于边赏月边吃月饼。月饼的形状象_____，是专门在中秋节____的食品，所以只有在中秋节前后才_____买到。近年来，随着中国经济的发展，月饼也越____越精致。一盒高级的_____的售价要在 300 元左右。中秋节时，月饼是送礼佳品。

Reading Four 阅读四 (please circle one item from the list of four)4 points

最近，中国出版研究做了一项调查。调查的对象是中国 18-39 岁的青年人；调查的内容是这些人的读书情况。调查的结果表明：中国的青年不读书的主要原因是“没有时间”，其次是“不习惯读书”，其中，在 20-29 岁的青年中，“没有时间读书”的人数最多。在其它不读书的原因中，“不知道读什么书”的人数比较多。可见，现在的大多数读者都需要在读书方面的科学的指导。

根据文章，接受中国出版研究调查的人是

A. 17 岁以上 40 岁以下的人　　B. 17 岁以下 39 岁以上的人

C. 17 岁以上的人　　D. 39 岁以下的人

根据文章，调查的内容是

A. 有多少人喜欢读书　　B. 哪些人不喜欢读书

C. 青年人不读书的原因　　D. 青年人读哪些书

根据文章，下面哪一个**不是**中国青年人不读书的原因？

A. 不 习惯读书　　B. 没有时间读书

C. 不知道读什么书　　D. 不喜欢读书

文章的作者认为

A. 青年人需要知道什么书值得读　　B. 青年人需要知道什么时间读书

C. 大多数读者都需要读科学书　　D. 大多数读者都不会读书

Reading Five 阅读五 (Please answer questions either in English or Chinese)6 points

一天夜里，下着大雨，父亲突然得了急病，儿子便带着父亲去医院。他们来到一个十字路口，正好遇到红灯。因为已经很晚了，所以路上很少有车和人。尽管这样，他们还是在雨中等了好久，但是红灯还是一直亮着。儿子忍不住了，便想闯红灯，可是父亲却批评了儿子不应该不守交通规则。儿子接受了批评，就这样，他们又等了五分钟，才发现，原来交通灯坏了，一直是红灯没有绿灯。

1. 儿子为什么要带父亲去医院？

2. 儿子为什么想闯红灯？

3．父亲为什么批评儿子？

4．你觉得父亲是一个什么样的人？

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